

## On the contingent valuation of mortality risk reduction in developing countries

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# On the contingent valuation of mortality risk reduction in developing countries

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## Abstract

Using the contingent valuation method in developing countries to value mortality risk reduction is particularly challenging because of the low level of education of the respondents. In this paper we investigate whether some brief training regarding probability and risk concepts has any significant effect on the WTP responses. We elicit individuals' risk perceptions by providing information on age specific mortality risks and find that people on average overestimate the mortality risk at younger ages and underestimate it at older ages. Our results indicate a significantly higher WTP for the trained sub-sample and WTP is sensitive to the magnitude of risk reduction for both the sub-samples.

**Keywords:** Bangladesh; contingent valuation; risk reduction; WTP; sensitivity to scope

**JEL Classification:** I1, D6, D8, H4

## Introduction

The contingent valuation (CV) method has been widely used to value mortality risk reduction but mostly in developed countries<sup>1</sup> (see Corso et al., 2001; Krupnick et al., 2002; Alberini et al., 2004; Liu et al., 2005). The CV method involves eliciting individuals' willingness-to-pay (WTP) for a hypothetical reduction in the risk of dying during a given time period. The individual's WTP can then be transformed into the value of a statistical life (VSL) by dividing the WTP by the magnitude of risk change in question (see for a theoretical discussion, Weinstein et al., 1980; Viscusi, 1993; Johannsson, 2002). However, most previous CV studies have found unreasonably low sensitivity of WTP to the size of risk reduction. One likely reason for the lack of sensitivity is a poor understanding of probabilities and a lack of intuition about small risk changes (see Hammitt and Graham 1999). Recent evidence suggests that there are ways to increase the sensitivity by using visual aids in the presentation of risks in the survey (see Corso et al., 2001; Krupnick et al., 2002; Alberini et al., 2004).

It is particularly challenging to use the CV method to elicit people's VSL in the context of developing countries. The main reason is the difficulty communicating probabilities and risk reduction to the respondents, since many either have very low levels of education or are illiterate. A brief training of the respondents in the survey regarding probability and risk concepts may enable the respondents to better process risk information. Thus the respondents will become more elaborate about their preferences for risk reduction; this should yield lower

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<sup>1</sup> There are some studies focusing on valuing health risks in developing countries but not particularly focusing on obtaining the VSL estimates (e.g. Cropper et al., 2004).

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variation in the responses as well as an increase in the sensitivity to scope. We investigate this in a CV study of mortality risk reduction among a random sample of rural households in Bangladesh. Nevertheless, the validity and reliability of the CV method is intensely debated (see e.g. Kahneman and Knetsch, 1992; Diamond and Hausman, 1994; Hanemann, 1994), some of the criticisms against the CV method such as “warm glow” or “the purchase of moral satisfaction” are not applicable when valuing individuals’ own risk reductions. For example, Hackl and Pruckner (2005) did not find strong empirical evidence of “strategic bias” or “warm glow” in a CV study of health care. Still, it can be highly cognitively demanding for the respondents to compare expected welfare effects from risk reductions with the effects of monetary changes (Beattie et al., 1998).

The remainder of the paper is organized as follows: Section 1 presents the CV survey, the training, the respondents’ risk understanding and risk perception, and the CV scenario. Section 2 presents the analysis of WTP results and the Section 3 presents a discussion of the main findings and the conclusions of the paper.

**1. The CV Survey**

Two versions of the CV survey were constructed: one version including some brief training vis-à-vis probability and risk, and the other without such training. Ideally, it would be better to train people for a longer period. However, we intend to see whether some brief training as part of the questionnaire makes any significant difference in the responses since such education is the most realistic kind that can be pursued. The complete CV survey was translated back to English from Bengali to ensure the exact meaning of the original English version.

The enumerators used to conduct the survey were trained regarding the risk presentations and the CV methodology following the guidelines of conducting CV studies in developing countries (see Whittington, 1998; 2002). Following several focus groups and two pilot studies, the final CV survey was conducted during October-November 2003 among 780 rural household heads in the selected 30 villages of the following five districts of Bangladesh: Netrokona, Mymensingh, Manikganj, Gazipur and Narayanganj. Table 1 presents the sample statistics.

>>> TABLE 1

Based on a *t*-test, we do not find any statistically significant differences ( $p\text{-value} > 0.05$ ) in terms of socio-economic characteristics between the populations of the two sub-samples, i.e. 'with training' and 'without training.' Therefore, differences in the WTP responses (relating to a specific risk reduction) between these two sub-samples could be attributed to receiving training in the survey. See the Appendix A1-A5 for detail on the CV questionnaire including how the respondents were trained in the survey.

### 1.1 The training regarding probability and risk concepts

The training involved concepts of probability of different events occurring, risks and implications of risk changes (see Appendix A1). In particular, we used coin flipping, dice throwing and a lottery example to introduce the concept of probabilities to the respondents. Mortality risk was discussed using the example of risk of dying from traffic accidents. The chance of winning in a lottery and the mortality risk examples were explained with the use of graph paper containing 100 and 1,000 squares, respectively (see Appendix A3). The respondents were asked test questions and a respondent is considered to have passed the entire test if

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he/she provided the correct answer to the three probability questions on dice throwing, lottery winning, and mortality risk at the first attempt (Table 2). Only 24% of the respondents passed the entire test. The respondents were, however, allowed three attempts, following repetitions of the examples, to provide a correct answer.

>>> TABLE 2

The meaning of the risk reductions was explained to the respondents by giving published information about the average risk of dying for an adult in Bangladesh in the next five years i.e. 40 in 1,000 (WHO, 2004) (see Appendix A2). Then they were told that with appropriate public policy this mortality risk could be reduced to, for example, 35 in 1,000, implying that 5 out of 40 lives could be saved. Similarly, further risk reductions, i.e. reducing the risk to 20 in 100 and 10 in 1000, were explained to the respondents up to three times to facilitate their understanding of the risk reductions. Almost 95% of the respondents revealed that they had understood all risk reduction examples after the first explanation and almost 98 % of the respondents preferred the largest risk reduction.

**1. 2 Objective risk and risk perception**

Before asking the CV questions, all respondents, including those without training, were first informed about the average mortality risk of persons aged 30-34 and persons aged 55-59 in the next five year period as 15 in 1,000 and 90 in 1,000, respectively. Then they were asked to mention their perceptions of their own risks of dying during the same period, taking into consideration particularly their ages, health and lifestyles (see Appendix A4).

Therefore, we customize the mortality risk for each individual according to his or her own perception. Based on the non-parametric Wilcoxon matched-pairs signed-rank test (see Siegel and Castellan (2000) for a description of the test), we can conclude that respondents' subjective and objective (age-related) risks are significantly different ( $p$ -value  $< 0.001$ ). As shown in Figure 1, people on average overestimate mortality risk at younger ages and underestimate it at older ages. This supports earlier findings in economics and psychology that people tend to overestimate small risks and underestimate large risks (e.g. Viscusi, 1992; Tversky and Kahneman, 1992; Kahneman and Tversky, 2000).

>>> FIGURE 1

### 1.3 The CV scenario

Finally, the respondents were asked about their WTP for either a 25% or 50% reduction in their perceived risk, which was to be achieved through a vaccination program. They were asked to state their maximum WTPs for obtaining the stated risk reduction (see Appendix A5). We choose the open-ended format as it provides more information than the closed-ended format<sup>2</sup>. Moreover, there is also experimental evidence showing that dichotomous choice (close ended questions) overestimates values more than the open-ended questions in the case of private goods (see Balistreri et al., 2001). Although vaccinations can be seen as a good with a positive externality, we find no indication that people consider this when deciding on their own vaccination. If the respondent stated zero WTP, he/she was asked several follow-up questions to ascertain possible scenario rejections. The

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<sup>2</sup> However, closed-ended format is the most favoured by researchers (e.g. Bateman et al., 2002; Hanley et al., 2003).



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responses can be divided into the following categories: (1) training and a 50% risk reduction, (2) training and a 25% risk reduction, (3) no training and a 50% risk reduction, and (4) no training and a 25% risk reduction.

**2. Analysis of WTP results**

Ten percent of the respondents (79 individuals) stated zero WTP for risk reduction. Based on the responses to follow-up questions we can conclude that, of these 79 responses, 84% indicates a scenario rejection (see Appendix B: Table 1). We do not include these responses in our further statistical analysis of this paper. However, we analyze the probability of scenario rejection using a standard probit model and observed that the Muslim respondents are more likely to provide a protest zero and, although significant at 10% level, the respondents receiving training in the survey are less likely to reject the scenario (for detail result, see Appendix B: Table 2). To control for WTP outliers in relation to income, we drop responses with WTP greater than 50% of households’ annual per capita income (although there is no *a priori* reason to assume that WTP for reducing the risk of dying should be a small part of income<sup>3</sup>, particularly since the payment for the risk reduction was to be made once for a five-year period). Table 3 reports the WTP distributions for different sub-samples.

>>> TABLE 3

We find that the mean WTP is TK. 487 (TK. 672) for a 25% (50%) risk reduction, for the no-training sub-sample. For the trained sub-sample, the mean WTP is TK. 671 (TK. 970) for a 25 % (50%) risk reduction. Using non-

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<sup>3</sup> Alberini (2005) discusses about the robustness of CV estimates and different types of outliers e.g. WTP outliers in relation to income.

parametric test<sup>4</sup>, we can reject the hypothesis that for the specific risk reduction (either 25% or 50%), WTP for the two sub-samples (training and no training) comes from the same underlying distribution (in both cases,  $p\text{-value} < 0.001$ ). These imply that the training in the CV survey increases the mean WTP. The results also indicate a smaller variation in the WTP responses for the training sub-sample, implying that some brief training facilitates respondent ability to better process the risk information.

We calculate the individual VSL by dividing the individual WTP by the magnitude of risk change offered to the respondents. The magnitude of the VSL estimates (US\$ 1,783 - \$2,922) are very low compared to the available estimates for developing countries. For example, using results from several VSL studies from other countries, Miller (2000) predicts a VSL for Bangladesh in the range of US\$ 30,000 to US \$1,000,000. However, the lower absolute VSLs in our case may be attributed to the fact that unlike many other studies we had relatively large risk reductions, if we assume that there is inadequate sensitivity to scope. For example, Carlsson et al. (2004) suggests that VSL tends to decrease rapidly when the size of the risk reduction increases.

We estimate a truncated regression model where WTP is truncated at zero, assuming homoscedasticity concerning the training; dummy variables are included identifying the training and the risk reduction levels in pooling the data.<sup>5</sup>

<sup>4</sup> Wilcoxon-Mann-Whitney test. See Siegel and Castellan (2000) for a description of the test.

<sup>5</sup> An appropriate econometric model for analyzing the WTP data that includes zeros would be Tobit with selection, which allows for modelling zero and positive WTP separately (see Carlsson and Johansson-Stenman, 2000). However, with only 13 (non-protest) zero WTP observations in our case, it is doubtful whether a sample selection model can be justified; it is also unclear whether

Table 4 reports the results. Assuming that people who passed the entire training would show higher sensitivity to scope compared to other respondents, separate interaction variables were included. Since several enumerators were used to conduct the CV survey, we control for the enumerators effects by including dummy variables for the enumerators; however, we do not present the enumerator coefficients in Table 4.

>>> TABLE 4

The training coefficient is highly significant and implies that WTP for a larger reduction in risk is 79% higher for the group receiving the training. The coefficient of 50% reduction is highly significant and indicates that WTP for the larger risk reduction is 45% higher than the WTP for the smaller reduction. The WTP difference concerning risk reduction is even higher for the training sub-sample (16% higher) in general and for the group who passed the tests (6% higher) in particular; however, none of these differences are statistically significant. We find that the more highly educated individuals have on average 7% higher WTPs compared to illiterate people; however, this difference is not statistically significant. Although it can be expected that people with higher levels of education might have higher values for risk reduction, other studies, e.g. Krupnick et al. (2002) and Alberini et al. (2004), have found that more highly educated people report lower WTPs.

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there is any true negative WTP. Given that the distributions of WTP significantly differ between the sub-samples, we first estimated a model allowing for heteroscedasticity concerning training. However, we cannot reject the null hypothesis of homoscedasticity (p value 0.96).

The estimated marginal effects for income<sup>6</sup> are positive and significant with an income elasticity of 0.43. The result that the income elasticity of the VSL is well below unity is also found in many other CV studies (e.g. Carlsson et al., 2004; Persson et al., 2001). In cross-country comparisons of VSL studies, Viscusi and Aldy (2003) found the income elasticity of VSL in the range of 0.5 to 0.6. We find that the effect of age on WTP is negative at younger ages, until a minimum is reached at age 46, and then increases. Alberini et al. (2004) found, using a sample of over 40-year olds that WTP does not decline until age 70. We also find that having a chronic illness has no significant effect on WTP; this result is consistent with Alberini et al. (2004) that having a chronic condition does not reduce the WTP for mortality risk. Finally, all else remaining the same, overall individual happiness significantly and positively affects WTP for risk reduction.

Based on the regression coefficients (Table 4), we can reject the hypothesis that WTP is insensitive to the magnitude of risk reduction for both the no-training and training sub-samples. The sensitivity to scope is higher for the trained sub-sample, although not statistically significant.

### 3. Discussion and conclusions

As elicited in the CV survey, individuals on average overestimate the risk at younger ages and underestimate the risk at older ages; the result is consistent with previous studies in the context of developed countries. On average, the individuals receiving training regarding probability and risk stated significantly

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<sup>6</sup> As the distribution of income in our sample is highly skewed we estimated separate models excluding relatively high income. However, as the coefficient of income remains roughly the same, we decided to keep them all in our final model presented here.

higher WTP for the risk reductions and the estimated WTP is sensitive to the size of the risk reduction. Although the implied VSL is higher for the trained subsample, it is still substantially lower compared to other studies, which may be attributed to the fact that compared to other studies we have used relatively large risk reductions. Moreover, stating WTP for a risk reduction is rather difficult for people unfamiliar with the idea of trading income for risk reduction. Therefore, it is likely that people would suffer from initial anchoring when constructing an answer as to how much they would be willing to pay (see Tversky and Kahneman, 1974; Kahneman et al., 1982). The respondents might anchor on the price of vaccination or on their other expenditures. In the context of a developing country, household consumption expenditures are usually low on average, particularly in the rural areas. Therefore, when placing a value on a desired and substantial risk reduction, the respondents might anchor initially to such low expenditures and adjust thereafter. In addition, a one-time payment rather than on-going monthly or yearly payments may result in more conservative estimates (see Carson, 2000).

In general, it appears constructive to train the respondents regarding probabilities and risk concepts in the CV risk reduction surveys. Training largely reduces the extent of cognitive burden that the respondents face in evaluating risk reductions and thereby increases the ability of the respondents to value the risk reduction. However, there might also be some associated problems with training in that the respondents may get tired if they find it boring and this may cause fatigue effects. Besides, by talking a lot about uncertainties and probabilities, the respondent can get the impression that avoiding risks is very important. Hence, they will tend to state higher WTP in the training version; this is not because they

are better trained but because they think that it is expected of them. While some respondents may respond in this way, others are able to draw inferences about the risk reduction, and training facilitates a cognitive structure that is essential to draw such inference in such a situation.

Finally, using the CV method to elicit people's VSLs is not a "mission impossible" in the context of developing countries. A comprehensible training on probability and risk concepts, interspersing risk examples with questions to check understanding as well as to maintain respondent interest, should be given in the CV risk reduction surveys. There are remaining problems but most of these appear to be related to the CV methodology *per se*, rather than to CV studies being performed in developing countries.

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**Table 1. Sample Statistics (N=767)**

Variable	Definition	Mean	Standard deviation
Male	Dummy variable=1 , if Male	0.91	0.28
Muslim religion	Dummy variable=1 if Muslim religion	0.66	0.47
Hindu religion	Dummy variable=1 if Hindu religion	0.34	0.47
Age	Age of the respondent	43.6	12.4
Income per capita	Total yearly household income was divided by [Number of adults + 0.5*number of children] <sup>0.75</sup>	22594	29117
Illiterate	Dummy variable=1, if cannot read and write	0.31	0.46
Low education	Dummy variable=1 , if not illiterate and/or education up to high school level)	0.55	0.50
High education	Dummy variable=1, if has education above high school level	0.14	0.35
Having chronic illness	Dummy variable=1, if the respondent has been suffering from any of the chronic diseases: heart disease, high blood pressure, asthma, bronchitis, cancer, or diabetes.	0.39	0.49
Currently smoking	Dummy variable=1, if the respondent currently smoking	0.56	0.50
Self reported happiness	Responses, on an 11-point scale, to the question: “As a whole, how happy would you say you are?” The scale is described as follows: 0 means “extremely unhappy,” 10 means “extremely happy”	5	2.2

**Table2. Understanding of probability and risk for the sub- sample with training**

Probability/ Risk questions <sup>a</sup>	% of respondents answered the test questions correctly
<u>Dice throwing question</u> : “when we roll a dice we may either see on the top 1, 2, 3, 4, 5, or 6, but we don’t know which one beforehand. Since there are six different numbers from 1 to 6, we may see any of them on the top. The chance of seeing a 5 on the top is 1/6. Now, if I throw this dice, what is the chance that 2 will be shown on top? “	31
<u>Lottery question</u> : “Now, suppose there are two lotteries. The chance of winning in one lottery is 5 in 1000 and the chance of winning in the other lottery is 10 in 1000. Which lottery has the larger chance of winning?”	74
<u>Mortality risk question</u> : “Now, suppose there are two roads that are both very prone to accidents. The risk of dying on road A is 1 in 1000 and the risk of dying on road B is 3 in 1000. Which road is more risky to take?”	83

<sup>a</sup> See Appendix A for test questions and the preceding examples.

**Table 3. WTP results for different sub samples <sup>a</sup>**

	No training		Training	
	25% risk reduction	50% risk reduction	25% risk reduction	50% risk reduction
Sample size	162	168	175	189
Mean WTP	487	672	671	970
Standard deviation	1531	1934	1377	1324
Median WTP	100	200	500	500
Mean WTP ratio <sup>b</sup>	1.38		1.45	
Null Hypothesis: Mean WTP ratio=1 <sup>c</sup>	p- value <0.001		p- value <0.001	
<i>VSL based on changes in subjective risk</i>				
Mean VSL	103074	106585	168905	107697
Median VSL	20000	13333	33333	30000
95% confidence interval for mean VSL	43742 – 162407	32164 – 181005	103714 – 134097	81167 - 134228

<sup>a</sup> WTP and VSL are expressed in Bangladesh Taka. 57.8 Taka =1 US \$, at the time of survey (October 2003).

<sup>b</sup> Ratio of mean WTP for a 50% risk reduction to mean WTP for a 25% risk reduction.

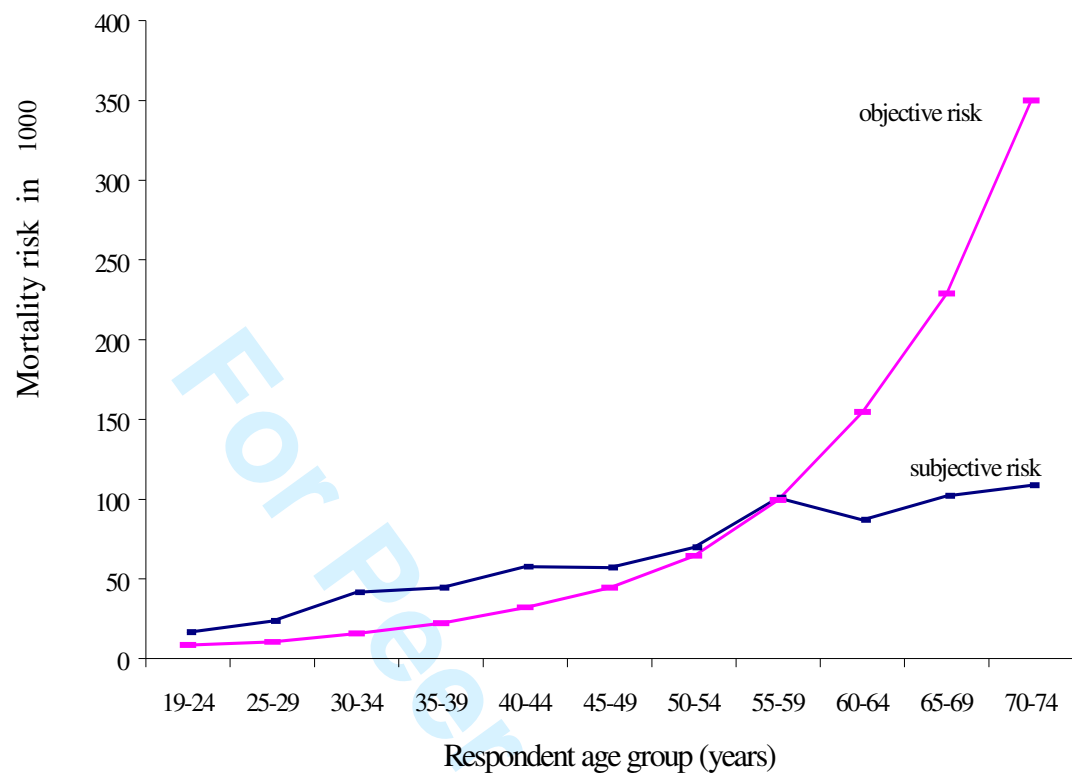
<sup>c</sup> Using both the non-parametric Wilcoxon –Man-Whitney test and the *t* test.

Table 4. Estimated WTP by sub-samples: Truncated regression model<sup>a</sup>

Dependent variable Log (WTP+1)		
Variable	Coefficient	Standard error
Constant	15.12**	6.89
Received training	0.583***	0.146
Passed probability test	0.170	0.230
50% risk reduction	0.371***	0.137
Received Training × 50% risk reduction	0.146	0.203
Passed probability test × 50% risk reduction	0.060	0.310
Muslim religion	-0.005	0.092
Log(age )	-7.02*	3.73
Log(age)-squared	0.912*	0.502
Log (subjective risk )	0.021	0.052
High education	0.070	0.090
Low education	-0.064	0.074
Log(Income per capita)	0.425***	0.063
Having chronic illness	-0.010	0.102
Currently smoking	0.016	0.102
Self reported happiness	0.070***	0.023
Disturbance standard deviation	1.22	0.033
Log-Likelihood	-1100.12	
Mean WTP ratio (No Training)	1.45	0.198
Mean WTP ratio (Training)	1.51	0.160

<sup>a</sup> The dependent variable is truncated at zero. Superscripts \*\*\* and \*\* denote statistical significance at the 1 % and 5% levels, respectively.

Figure 1. Objective and subjective mortality risk during the next five years as a function of age



## Appendix A1: Training on Probability and risk examples

Now I will discuss the chances and risks of events occurring using some examples.

**Example 1:** Sometimes we toss a coin to decide which of two things to choose. When we toss a coin [Enumerator: show tossing a coin], we get either a head or a tail. We cannot be sure of the result of the toss. As there are two things that can happen from a coin toss, the chance of getting a head is 1 in 2. The same is true for getting a tail.

Similarly, when we roll a dice (chakka) [Enumerator: show throwing a chakka] we may either see on the top 1, 2, 3, 4, 5, or 6, but we don't know which one beforehand. Since there are six different numbers from 1 to 6, we may see any of them on the top. The chance of seeing a 5 on the top is  $1/6$ .

Is this example clear to you?

[Enumerator: If no, explain again and make sure that the respondent understands. Write down how many times you had to explain. If the respondent has not understood after three times, write "4" and continue.]

**Question PT1.** Now, if I throw this “chakka” (dice), what is the chance that 2 will be shown on top?

Answer:

[Enumerator: If the answer is wrong, explain with example until the correct answer is given. Write down how many times you had to explain. If the respondent did not have it right after a third explanation, explain the answer and write 4. ]

**Example 2:** Consider buying a lottery ticket. Many people buy lottery tickets and most people do not win. Suppose that there is only 1 prize in a lottery and 100 people buy one lottery ticket each. [Enumerator: Show grid table 1]. In this case we say that the chance of winning the prize will be 1 in 100.

Is this example clear to you?

[Enumerator: If no, explain again and make sure that the respondent understands. Write down how many times you had to explain. If the respondent has not understood after three times, write "4" and continue.]

**Question PT2.** Now, suppose there are two lotteries. The chance of winning in one lottery is 5 in 1000 and the chance of winning in the other lottery is 10 in 1000. [Enumerator: Show the grid table- 2 and grid table 3, when explaining]. Which lottery has the larger chance of winning?

5 in 1000      1

10 in 1000 2

Answer: .....

[Enumerator: If the answer is wrong, explain with example until the correct answer is given. Write down how many times you had to explain. If the respondent did not have it right after a third explanation, explain the answer and write 4. ]

**Example3/ Question PT3.** Now, suppose there are two roads that are both very prone to accidents. The risk of dying on road A is 1 in 1000 and the risk of dying on road B is 3 in 1000. [Enumerator: Show the grid table-4 and grid table 5, when explaining]. Which road is more risky to take?

Road A	1
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Road B 2

[Enumerator: If the answer is wrong, explain with example until the correct answer is given. Write down how many times you had to explain. If the respondent did not have it right after a third explanation, explain the answer and write 4. ]

## Appendix A2: Training - Explaining risk reduction

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**Example 4:** Suppose the average risk of dying for an adult person during the next 5 years is 40 in 1000. [Enumerator: show grid table 6 when explaining].

Suppose a reduction in mortality risk, through some kind of public measure, could reduce the mortality risk from 40 in 1000 to 35 in 1000

[Enumerator: show grid table 6 and grid table 7 together to explain the difference].

This means that, on average, 5 out of 40 would be saved by the measure.

**PT4.** Do you understand this risk reduction?

Yes 1

No 2

[Enumerator: If no, explain again and make sure that the respondent understands and write down how many times you had to explain. If the respondent has not understood after three times, continue and write 4]

**Example 5:** Similarly, if the risk was reduced from 40 in 1000 to 20 in 1000[Show grid table 6 and grid table 8 together to explain the difference], then 20 out of 40 would be saved on average.

**PT5.** Do you understand this risk reduction?

Yes 1

No 2

[Enumerator: If no, explain again and make sure that the respondent understands and write down how many times you had to explain. If the respondent has not understood after three times, continue and write 4]

Answer:

**Example 6:** If the risk was reduced from 40 in 1000 to 10 in 1000[show grid table 6 and grid table 9 together to explain the difference], then 30 out of 40 would be saved on average.

**PT6.** Do you understand this risk reduction?

Yes 1

No 2

[Enumerator: If no, explain again and make sure that the respondent understands and write down how many times you had to explain. If the respondent has not understood after three times, continue and write 4]

Answer:

**Example 7/ Question**

**PT7.** Which of the above risk reductions would you prefer?

[Enumerator: Show the cards and let the respondent point]

a) 40 in 1000 to 35 in 1000

b) 40 in 1000 to 20 in 1000

c) 40 in 1000 to 10 in 1000

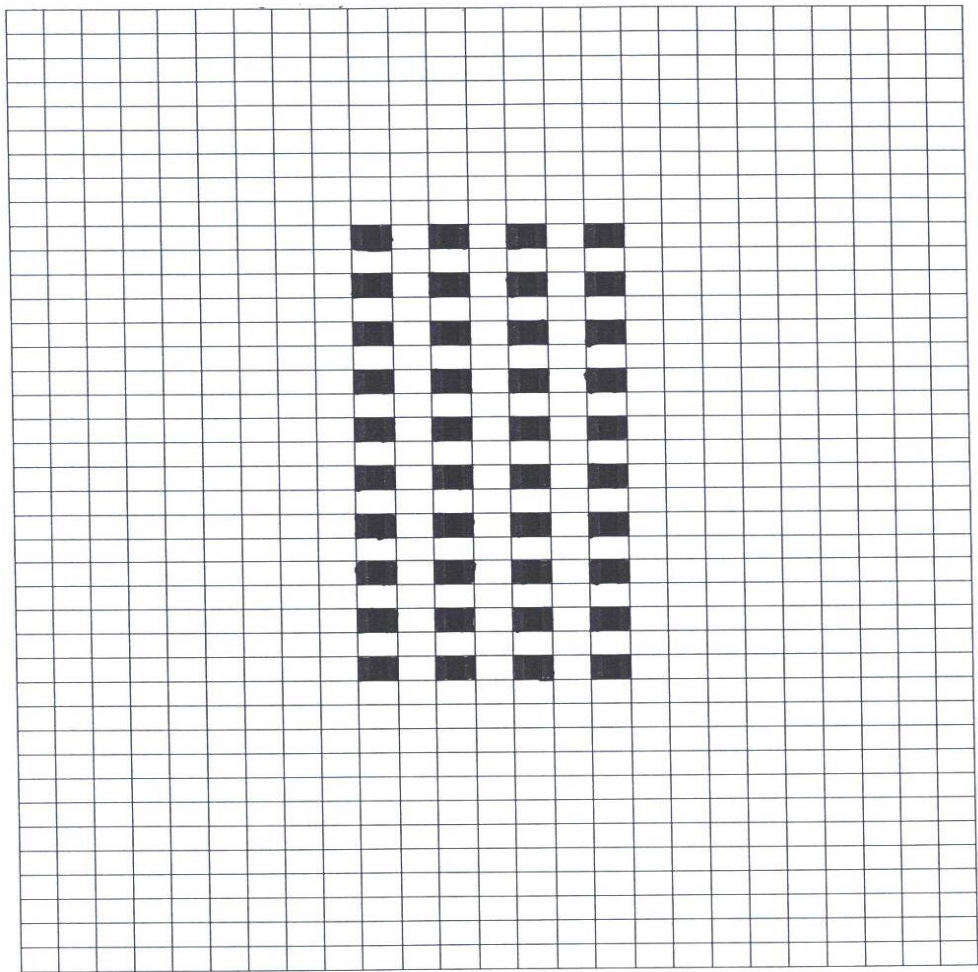
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**Appendix A3: Grid table showing mortality risk of an adult in the next five years as 40 in 1000**

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[Enumerator: Use the grid table 12, which is an empty grid table to represent the respondent's subjective risk of dying in the next five years. Let the respondent look at it.]

CV1. What is the maximum, as a one-time fee, you would be willing to pay to obtain such vaccines for yourself? You should also remember that if you were to pay for the vaccines, you would have less money left for other purposes. Maximum  
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Appendix B

Table 1. Follow-up questions for stating zero WTP (N = 79)

		Sub-sample of respondents who would want free vaccination (77%)	Sub-sample of respondents who would not want free vaccination (23%)
Reasons for not being willing to pay for vaccination <sup>a</sup>		% of respondents agree	
i)	I cannot afford vaccinations, even though I believe it is good to have them.	79%	-
ii)	I think the government should pay for the vaccinations.	77%	11%
iii)	I do not think the vaccine would really be safe.	-	17%
iv)	I do not think it is possible to reduce the mortality risk by vaccines.	7%	33%
v)	I do not believe in reducing mortality risk by any means.	7%	44%
vi)	Other reasons stated by the respondents: Reluctant to answer, not interested, dislike vaccination, not sure if (s) he would be willing to pay for vaccination.	3%	39%

<sup>a</sup> The lists of possible reasons were read to them and the respondents were allowed to choose more than one reason. They were also allowed to express other reasons. Respondents who had chosen any response than (i) or had chosen more than one responses are believed to have provided protest zeros when answering the WTP question.

Table 2 Probit regression of scenario rejection (N=79)

Variable	Marginal effects	Standard error
Received training in the survey	-0.120	0.085
50% risk reduction	-0.067	0.081
Age in years	0.005	0.002
Low education <sup>a</sup>	0.144	0.093
Muslim religion	0.416***	0.145
Log (income per capita)	0.477	0.482
Having chronic illness	-0.065	0.084
Currently smoking	-0.138	0.109

Superscripts \*\*\*, \*\*, \* denote statistical significance at the 1 %, 5%, and 10% level, respectively.

<sup>a</sup> We cannot estimate the marginal effect of high education as all eight observations from this group are dropped because, for this group, all the zero WTPs imply a scenario rejection.

# On the contingent valuation of mortality risk reduction in developing countries

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## Abstract

Using the contingent valuation method in developing countries to value mortality risk reduction is particularly challenging because of the low level of education of the respondents. In this paper, we investigate whether some brief training regarding probability and risk concepts has any significant effect on the WTP responses. We elicit individuals' risk perceptions by providing information on age specific mortality risks and find that people on average overestimate the mortality risk at younger ages and underestimate it at older ages. Our results indicate a significantly higher WTP for the trained sub-sample and WTP is sensitive to the magnitude of risk reduction for both the sub-samples.

**Keywords:** Bangladesh; contingent valuation; risk reduction; WTP; sensitivity to scope

JEL Classification: I1, D6, D8, H4

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**Introduction**

The contingent valuation (CV) method has been widely used to value mortality risk reduction but mostly in developed countries<sup>1</sup> (see Corso et. al., 2001; Krupnick et al., 2002; Alberini et al., 2004; Liu et al., 2005). The CV method involves eliciting individuals' willingness-to-pay (WTP) for a hypothetical reduction in the risk of dying during a given time period. The individual's WTP can then be transformed into the value of a statistical life (VSL) by dividing the WTP by the magnitude of risk change in question (see for a theoretical discussion, Weinstein et al., 1980; Viscusi, 1993; Johannsson, 2002). The theory predicts that WTP for mortality risk reduction should be positively associated with the magnitude of risk reduction. Furthermore, for sufficiently small risk changes, WTP should be nearly proportional to the magnitude of risk reduction.<sup>2</sup> However, most previous CV studies have found unreasonably low sensitivity of WTP to the size of risk reduction. One likely reason for the lack of sensitivity is a poor understanding of probabilities and a lack of intuition about small risk changes (Hammitt and Graham 1999). Recent evidence suggests that there are ways to increase the sensitivity by using visual aids in the presentation of risks in the survey (see Corso et. al., 2001; Krupnick et al., 2002; Alberini et al., 2004).

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<sup>1</sup>There are some studies focusing on valuing health risks in developing countries but not particularly focusing on obtaining the VSL estimates (e.g. Cropper et. al., 2004).

<sup>2</sup> This means e.g. that WTP should be twice as high for a two- fold reduction in risk. For substantially large risk changes, however, theoretical prediction of proportionality would not hold, i.e., WTP would increase but less than proportionally to the risk changes and hence the resulting VSL can be smaller compared to the case when small risk changes are valued.

It is particularly challenging to use the CV method to elicit people's VSL in the context of developing countries. The main reason is the difficulty communicating probabilities and risk reduction to the respondents, since many either have very low levels of education or are illiterate. Moreover, most people, being unfamiliar with the concept of risk-money tradeoffs, might face greater uncertainty in placing a value for the risk reduction. A brief training of the respondents in the survey regarding probability and risk concepts may enable the respondents to better process risk information. The lack of understanding or unfamiliarity of the object of valuation can largely affect respondents' valuation behaviour in the context of CV studies. For example, variance of values is found to decrease with the degree of familiarity (knowledge) regarding the object of valuation both in hypothetical as well as experimental setting (Paradiso and Trisorio, 2001). Recent evidence also shows that WTP answers from respondents with higher cognitive ability are less flawed by scale bias i.e., insensitivity and non-near proportionality of WTP to the size of the risk reduction (Andersson and Svensson, 2006). One would expect that training largely reduces the extent of cognitive burden that the respondents face in evaluating risk reductions and thereby increases the ability of the respondents to value the risk reduction. Thus the respondents will become more elaborate about their preferences for risk reduction; this should yield lower variation in the responses as well as an increase in the sensitivity to scope. An increase in the sensitivity to scope would mean an increase in the proportionality of WTP to the risk changes, i.e. an increase in the ratio of mean WTP for larger risk reduction to mean WTP for smaller risk reduction. However, there might be some problems associated with the training. By talking a lot about uncertainties

and probabilities, the respondent can get the impression that avoiding risks is very important. Hence, they will tend to state higher WTP in the training version; this is not because they are better trained but because they think that it is expected of them. Besides, the respondents may get tired if they find it boring and this may cause fatigue effects. Thus the training may also significantly affect (bias) the stated WTP; the ultimate problem, however, with any test of this kind, i.e. the effect of training on WTP values, is that one does not have the “true” WTP as a base-line.

In this paper, we investigate how training regarding probability and risk concepts affects respondents’ WTP response in a CV study of mortality risk reduction among a random sample of rural households in Bangladesh. Nevertheless, the validity and reliability of the CV method is intensely debated (see e.g. Kahneman and Knetsch, 1992; Diamond and Hausman, 1994; Hanemann, 1994), some of the criticisms against the CV method such as “warm glow” or “the purchase of moral satisfaction” are not applicable when valuing individuals’ own risk reductions. For example, Hackl and Pruckner (2005) did not find strong empirical evidence of “strategic bias” or “warm glow” in a CV study of health care. Still, it can be highly cognitively demanding for the respondents to compare expected welfare effects from risk reductions with the effects of monetary changes (Beattie et al., 1998).

The remainder of the paper is organized as follows: Section 1 presents the CV survey, the training, the respondents’ risk understanding and risk perception, and the CV scenario. Section 2 presents the analysis of WTP results and the



Section 3 presents a discussion of the main findings and the conclusions of the paper.

### 1. The CV Survey

Two versions of the CV survey were constructed: one version including some brief training vis-à-vis probability and risk, and the other without such training. Ideally, it would be better to train people for a longer period. However, we intend to see whether some brief training as part of the questionnaire makes any significant difference in the responses since such education is the most realistic kind that can be pursued. The complete CV survey was translated back to English from Bengali to ensure the exact meaning of the original English version. The enumerators used to conduct the survey were trained regarding the risk presentations and the CV methodology following the guidelines of conducting CV studies in developing countries (see Whittington, 1998; 2002). Following several focus groups and two pilot studies, the final CV survey was conducted during October-November 2003 among 780 rural household heads in the selected 30 villages of the following five districts of Bangladesh: Netrokona, Mymensingh, Manikganj, Gazipur and Narayanganj. Table 1 presents the sample statistics.

#### >>> TABLE 1

Based on a *t*- test, we do not find any statistically significant differences ( $p\text{-value} > 0.05$ ) in terms of socio-economic characteristics between the populations of the two sub-samples, i.e. ‘with training’ and ‘without training.’ Therefore, differences in the WTP responses (relating to a specific risk reduction) between these two sub-samples could be attributed to receiving training in the



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survey. See the Appendix A1-A5 for detail on the CV questionnaire including how the respondents were trained in the survey.

**1.1 The training regarding probability and risk concepts**

The training involved concepts of probability of different events occurring, risks and implications of risk changes (see Appendix A1). In particular, we used coin flipping, dice throwing and a lottery example to introduce the concept of probabilities to the respondents. Mortality risk was discussed using the example of risk of dying from traffic accidents. The chance of winning in a lottery and the mortality risk examples were explained with the use of graph paper containing 100 and 1,000 squares, respectively(see Appendix A3). The respondents were asked test questions and a respondent is considered to have passed the entire test if he/she provided the correct answer to the three probability questions on dice throwing, lottery winning, and mortality risk at the first attempt (Table 2). Only 24% of the respondents passed the entire test. The respondents were, however, allowed three attempts, following repetitions of the examples, to provide a correct answer.

>>> TABLE 2

The meaning of the risk reductions was explained to the respondents by giving published information about the average risk of dying for an adult in Bangladesh in the next five years i.e. 40 in 1,000 (WHO, 2004) (see Appendix A2). Then they were told that with appropriate public policy this mortality risk could be reduced to, for example, 35 in 1,000, implying that 5 out of 40 lives could be saved. Similarly, further risk reductions, i.e. reducing the risk to 20 in 100 and 10 in 1000, were explained to the respondents up to three times to

facilitate their understanding of the risk reductions. Almost 95% of the respondents revealed that they had understood all risk reduction examples after the first explanation and almost 98 % of the respondents preferred the largest risk reduction.

## 1. 2 Objective risk and risk perception

Before asking the CV questions, all respondents, including those without training, were first informed about the average mortality risk of persons aged 30-34 and persons aged 55-59 in the next five year period as 15 in 1,000 and 90 in 1,000, respectively. Then they were asked to mention their perceptions of their own risks of dying during the same period, taking into consideration particularly their ages, health and lifestyles (see Appendix A4).

Therefore, we customize the mortality risk for each individual according to his or her own perception. Based on the non-parametric Wilcoxon matched-pairs signed-rank test (see Siegel and Castellan (2000) for a description of the test), we can conclude that respondents' subjective and objective (age-related) risks are significantly different ( $p$ -value  $< 0.001$ ). As shown in Figure 1, people on average overestimate mortality risk at younger ages and underestimate it at older ages. This supports earlier findings in economics and psychology that people tend to overestimate small risks and underestimate large risks (e.g. Viscusi, 1992; Tversky and Kahneman, 1992; Kahneman and Tversky, 2000).

>>> FIGURE 1

## 1.3 The CV scenario

Finally, the respondents were asked about their WTP for either a 25% or 50% reduction in their perceived risk, which was to be achieved through a

vaccination program. They were asked to state their maximum WTPs for obtaining the stated risk reduction (see Appendix A5). We choose the open-ended format as it provides more information than the closed-ended format, although the latter is the most favoured by CV researchers (see Bateman et al., 2002; Hanely et al., 2003). Moreover, there is also experimental evidence showing that dichotomous choice (close ended questions) overestimates values more than the open-ended questions in the case of private goods (e.g. Balistreri et al., 2001).<sup>3</sup> Although vaccinations can be seen as a good with a positive externality, we find no indication that people consider this when deciding on their own vaccination. If the respondent stated zero WTP, he/she was asked several follow-up questions to ascertain possible scenario rejections. The responses can be divided into the following categories: (1) training and a 50% risk reduction, (2) training and a 25% risk reduction, (3) no training and a 50% risk reduction, and (4) no training and a 25% risk reduction.

**2. Analysis of WTP results**

Ten percent of the respondents (79 individuals) stated zero WTP for risk reduction. Based on the responses to follow-up questions we can conclude that, of these 79 responses, 84% indicates a scenario rejection (see Appendix B: Table 1). We do not include these responses in our further statistical analysis of this paper. However, we analyze the probability of scenario rejection using a standard probit model and observed that the Muslim respondents are more likely to provide a protest zero and, although significant at 10% level, the respondents receiving

<sup>3</sup> For experimental results suggesting disparities between hypothetical and actual (real) WTP, also see Johannesson et al., 1998; Frykblom, 2000; Bothelo and Pinto, 2002.

training in the survey are less likely to reject the scenario (for detail result, see Appendix B: Table 2). To control for WTP outliers in relation to income, we drop responses with WTP greater than 50% of households' annual per capita income (although there is no *a priori* reason to assume that WTP for reducing the risk of dying should be a small part of income<sup>4</sup>, particularly since the payment for the risk reduction was to be made once for a five-year period). Table 3 reports the WTP distributions for different sub-samples.

### >>> TABLE 3

We find that the mean WTP is TK. 487 (TK. 672) for a 25% (50%) risk reduction, for the no-training sub-sample. For the trained sub-sample, the mean WTP is TK. 671 (TK. 970) for a 25 % (50%) risk reduction. Using non-parametric Wilcoxon-Mann-Whitney test,<sup>5</sup> we can reject the hypothesis that for the specific risk reduction (either 25% or 50%), WTP for the two sub-samples (training and no training) comes from the same underlying distribution (in both cases, p-value<0.001). These imply that the training in the CV survey increases the mean WTP. The results also indicate a smaller variation in the WTP responses for the training sub-sample, implying that some brief training facilitates respondent ability to better process the risk information. Further test concerning the difference in variances is followed in the econometric analysis.

We calculate the individual VSL by dividing the individual WTP by the magnitude of risk change offered to the respondents. The magnitude of the VSL

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<sup>4</sup>Alberini (2005) discusses about the robustness of CV estimates and different types of outliers e.g. WTP outliers in relation to income.

<sup>5</sup> See Siegel and Castellan (2000), for a description of the test.

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estimates (US\$ 1,783 -\$2,922) are very low compared to the available estimates for developing countries. For example, using results from several VSL studies from other countries, Miller (2000) predicts a VSL for Bangladesh in the range of US\$ 30,000 to US \$1,000,000. However, the lower absolute VSLs in our case may be attributed to the fact that unlike many other studies we had relatively large risk reductions, if we assume that there is inadequate sensitivity to scope. For example, Carlsson et al. (2004) suggests that VSL tends to decrease rapidly when the size of the risk reduction increases.

We estimate a truncated regression model where WTP is truncated at zero.<sup>6</sup> Given that the distributions of WTP differ between the sub-samples (Table 3), we first estimated a model allowing for heteroscedasticity concerning training. However, we cannot reject the null hypothesis of homoscedasticity (p value 0.96); the variances of WTP between the two sub-samples do not differ significantly. Hence we estimate the model assuming homoscedasticity concerning the training; dummy variables are included identifying training and the risk reduction levels in pooling the data. Table 4 reports the results. Assuming that people who passed the entire training would show higher sensitivity to scope compared to other respondents, separate interaction variables were included. Since several enumerators were used to conduct the CV survey, we control for the enumerators

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<sup>6</sup> An appropriate econometric model for analyzing the WTP data that includes zeros would be a two-equation sample selection model that allows for modeling zero and positive WTP separately (e.g. Carlsson and Johansson-Stenman, 2000; Yoo et al., 2001; Strazzer et al., 2003). However, with only 13 (non-protest) zero WTP observations in our case, it is doubtful whether a sample selection model can be justified; it is also unclear whether there is any true negative WTP.

effects by including dummy variables for the enumerators; however, we do not present the enumerator coefficients in Table 4.

#### >>> TABLE 4

The training coefficient is highly significant and implies that WTP for a larger reduction in risk is 79% higher for the group receiving the training. The coefficient of 50% reduction is highly significant and indicates that WTP for the larger risk reduction is 45% higher than the WTP for the smaller reduction. The WTP difference concerning risk reduction is even higher for the training subsample (16% higher) in general and for the group who passed the tests (6% higher) in particular; however, none of these differences are statistically significant. We find that the more highly educated individuals have on average 7% higher WTPs compared to illiterate people; however, this difference is not statistically significant. Although it can be expected that people with higher levels of education might have higher values for risk reduction, other studies, e.g. Krupnick et al. (2002) and Alberini et al. (2004), have found that more highly educated people report lower WTPs.

The estimated marginal effects for income<sup>7</sup> are positive and significant with an income elasticity of 0.43. The result that the income elasticity of the VSL is well below unity is also found in many other CV studies (e.g. Carlsson et al., 2004; Persson et al., 2001). In cross-country comparisons of VSL studies, Viscusi and Aldy (2003) found the income elasticity of VSL in the range of 0.5 to 0.6.

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<sup>7</sup> As the distribution of income in our sample is highly skewed we estimated separate models excluding relatively high income. However, as the coefficient of income remains roughly the same, we decided to keep them all in our final model presented here.

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We find that the effect of age on WTP is negative at younger ages, until a minimum is reached at age 46, and then increases. Alberini et al. (2004) found, using a sample of over 40-year olds that WTP does not decline until age 70. We also find that having a chronic illness has no significant effect on WTP; this result is consistent with Alberini et al. (2004) that having a chronic condition does not reduce the WTP for mortality risk. Finally, all else remaining the same, overall individual happiness significantly and positively affects WTP for risk reduction.

From the estimated results, we formally test for the sensitivity to scope. We calculate the mean WTPratio, i.e. ratio of mean WTP for a 50% risk reduction to mean WTP for a 25% risk reduction, using the regression coefficients. The WTP ratios for both the sub-samples, and the difference between two mean WTP ratios are presented along with 95% confidence intervals and standard errors in Table 4. We can reject the hypothesis that WTP is insensitive to the magnitude of risk reduction for both the no-training and training sub-samples. The sensitivity to scope is higher (higher mean WTP ratio) for the trained sub-sample; however the difference in the sensitivity to scope is not statistically significant.

**3. Discussion and conclusions**

As elicited in the CV survey, individuals on average overestimate the risk at younger ages and underestimate the risk at older ages; the result is consistent with previous studies in the context of developed countries. On average, the individuals receiving training regarding probability and risk stated significantly higher WTP for the risk reductions and the estimated WTP is sensitive to the size of the risk reduction. Although the implied VSL is higher for the trained sub-sample, it is still substantially lower compared to other studies, which may be attributed to the

fact that compared to other studies we have used relatively large risk reductions. Moreover, stating WTP for a risk reduction is rather difficult for people unfamiliar with the idea of trading income for risk reduction. Therefore, it is likely that people would suffer from initial anchoring when constructing an answer as to how much they would be willing to pay (see Tversky and Kahneman, 1974; Kahneman et al., 1982). The respondents might anchor on the price of vaccination or on their other expenditures. In the context of a developing country, household consumption expenditures are usually low on average, particularly in the rural areas. Therefore, when placing a value on a desired and substantial risk reduction, the respondents might anchor initially to such low expenditures and adjust thereafter. In addition, a one-time payment rather than on-going monthly or yearly payments may result in more conservative estimates (see Carson, 2000).

In general, it appears constructive to train the respondents regarding probabilities and risk concepts in the CV risk reduction surveys. Training largely reduces the extent of cognitive burden that the respondents face in evaluating risk reductions and thereby increases the ability of the respondents to value the risk reduction. However, we find no significant difference in the variance of WTP, but rather in the levels. As discussed earlier, besides the possibility of fatigue effects, respondents in the training version can get the impression that avoiding risks is very important and that a higher value is expected of them, which may bias their stated WTP. While some respondents may respond in this way, others are able to draw inferences about the risk reduction, and training facilitates a cognitive structure that is essential to draw such inference in such a situation.



Finally, using the CV method to elicit people's VSLs is not a "mission impossible" in the context of developing countries. A comprehensible training on probability and risk concepts, interspersing risk examples with questions to check understanding as well as to maintain respondent interest, should be given in the CV risk reduction surveys. There are remaining problems but most of these appear to be related to the CV methodology *per se*, rather than to CV studies being performed in developing countries.

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**Table 1. Sample Statistics (N=767)**

Variable	Definition	Mean	Standard deviation
Male	Dummy variable=1 , if Male	0.91	0.28
Muslim religion	Dummy variable=1 if Muslim religion	0.66	0.47
Hindu religion	Dummy variable=1 if Hindu religion	0.34	0.47
Age	Age of the respondent	43.6	12.4
Income per capita	Total yearly household income was divided by [Number of adults + 0.5*number of children] <sup>0.75</sup>	22594	29117
Illiterate	Dummy variable=1, if cannot read and write	0.31	0.46
Low education	Dummy variable=1 , if not illiterate and/or education up to high school level)	0.55	0.50
High education	Dummy variable=1, if has education above high school level	0.14	0.35
Having chronic illness	Dummy variable=1, if the respondent has been suffering from any of the chronic diseases: heart disease, high blood pressure, asthma, bronchitis, cancer, or diabetes.	0.39	0.49
Currently smoking	Dummy variable=1, if the respondent currently smoking	0.56	0.50
Self reported happiness	Responses, on an 11-point scale, to the question: “As a whole, how happy would you say you are?” The scale is described as follows: 0 means “extremely unhappy,” 10 means “extremely happy”	5	2.2

**Table 2. Understanding of probability and risk for the sub- sample with training**

Probability/ Risk questions <sup>a</sup>	% of respondents answered the test questions correctly
<u>Dice throwing question</u> : “when we roll a dice we may either see on the top 1, 2, 3, 4, 5, or 6, but we don’t know which one beforehand. Since there are six different numbers from 1 to 6, we may see any of them on the top. The chance of seeing a 5 on the top is 1/6. Now, if I throw this dice, what is the chance that 2 will be shown on top?”	31
<u>Lottery question</u> : “Now, suppose there are two lotteries. The chance of winning in one lottery is 5 in 1000 and the chance of winning in the other lottery is 10 in 1000. Which lottery has the larger chance of winning?”	74
<u>Mortality risk question</u> : “Now, suppose there are two roads that are both very prone to accidents. The risk of dying on road A is 1 in 1000 and the risk of dying on road B is 3 in 1000. Which road is more risky to take?”	83

<sup>a</sup> See Appendix A for test questions and the preceding examples.

**Table 3. WTP results for different sub samples <sup>a</sup>**

Table 5: WTP Results for different size samples				
	No training		Training	
	25% risk reduction	50% risk reduction	25% risk reduction	50% risk reduction
Sample size	162	168	175	189
Mean WTP	487	672	671	970
Standard deviation	1531	1934	1377	1324
Median WTP	100	200	500	500
Mean WTP ratio <sup>b</sup>	1.38		1.45	
Null Hypothesis: Mean WTP ratio=1 <sup>c</sup>	p- value <0.001		p- value <0.001	
<i>VSL based on changes in subjective risk</i>				
Mean VSL	103074	106585	168905	107697
Median VSL	20000	13333	33333	30000
95% confidence interval for mean VSL	43742 – 162407	32164 – 181005	103714 – 134097	81167 - 134228

<sup>a</sup> WTP and VSL are expressed in Bangladesh Taka. 57.8 Taka =1 US \$, at the time of survey (October 2003).

<sup>b</sup> Ratio of mean WTP for a 50% risk reduction to mean WTP for a 25% risk reduction.

<sup>c</sup> Using both the non-parametric Wilcoxon –Man-Whitney test and the *t* test.



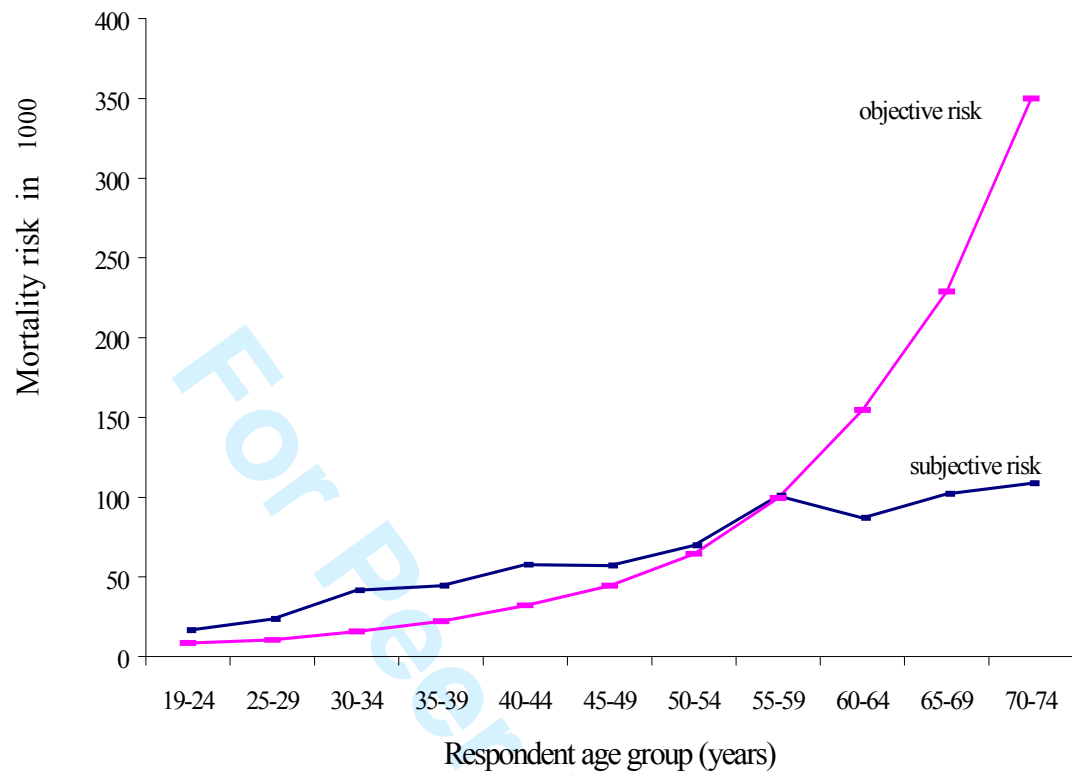
Table 4. Estimated WTP by sub-samples: Truncated regression model<sup>a</sup>

Dependent variable Log (WTP+1)		
Variable	Coefficient	Standard error
Constant	15.12**	6.89
Received training	0.583***	0.146
Passed probability test	0.170	0.230
50% risk reduction	0.371***	0.137
Received Training × 50% risk reduction	0.146	0.203
Passed probability test × 50% risk reduction	0.060	0.310
Muslim religion	-0.005	0.092
Log(age )	-7.02*	3.73
Log(age)-squared	0.912*	0.502
Log (subjective risk )	0.021	0.052
High education	0.070	0.090
Low education	-0.064	0.074
Log(Income per capita)	0.425***	0.063
Having chronic illness	-0.010	0.102
Currently smoking	0.016	0.102
Self reported happiness	0.070***	0.023
Disturbance standard deviation	1.22	0.033
Log-Likelihood	-1100.12	
<b>Sensitivity to Scope <sup>b</sup></b>		
Mean WTP ratio (No Training)	1.45	0.198
	(1.06-1.84)	
Mean WTP ratio (Training)	1.51	0.160
	(1.20-1.83)	
Difference of mean WTP ratios between two sub-samples	0.06	0.073
	(-0.08-0.21)	

<sup>a</sup> The dependent variable is truncated at zero. Superscripts \*\*\* and \*\* denote statistical significance at the 1 % and 5% levels, respectively.

<sup>b</sup> The mean WTP ratio is defined as the ratio of mean WTP for a 50% risk reduction to mean WTP for a 25% risk reduction. The ratio is calculated using the regression coefficients of the dummy variable for risk reduction and the mean values of other explanatory variables. Difference of mean WTP ratio between two sub-samples indicates that the sensitivity to scope is higher for the training sub-sample. The standard errors of mean WTP ratios are calculated using the Delta Method (see Greene 2000). 95% Confidence intervals are reported in the parenthesis.

Figure 1. Objective and subjective mortality risk during the next five years as a function of age



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**Appendix A1: Training on Probability and risk examples**

Now I will discuss the chances and risks of events occurring using some examples.

**Example 1:** Sometimes we toss a coin to decide which of two things to choose. When we toss a coin [Enumerator: show tossing a coin], we get either a head or a tail. We cannot be sure of the result of the toss. As there are two things that can happen from a coin toss, the chance of getting a head is 1 in 2. The same is true for getting a tail.

Similarly, when we roll a dice (chakka) [Enumerator: show throwing a chakka] we may either see on the top 1, 2, 3, 4, 5, or 6, but we don't know which one beforehand. Since there are six different numbers from 1 to 6, we may see any of them on the top. The chance of seeing a 5 on the top is 1/6.

Is this example clear to you?

[Enumerator: If no, explain again and make sure that the respondent understands. Write down how many times you had to explain. If the respondent has not understood after three times, write "4" and continue.]

**Question PT1.** Now, if I throw this "chakka" (dice), what is the chance that 2 will be shown on top?

Answer:

[Enumerator: If the answer is wrong, explain with example until the correct answer is given. Write down how many times you had to explain. If the respondent did not have it right after a third explanation, explain the answer and write 4. ]

**Example 2:** Consider buying a lottery ticket. Many people buy lottery tickets and most people do not win. Suppose that there is only 1 prize in a lottery and 100 people buy one lottery ticket each. [Enumerator: Show grid table 1]. In this case we say that the chance of winning the prize will be 1 in 100.

Is this example clear to you?

[Enumerator: If no, explain again and make sure that the respondent understands. Write down how many times you had to explain. If the respondent has not understood after three times, write "4" and continue.]

**Question PT2.** Now, suppose there are two lotteries. The chance of winning in one lottery is 5 in 1000 and the chance of winning in the other lottery is 10 in 1000. [Enumerator: Show the grid table- 2 and grid table 3, when explaining]. Which lottery has the larger chance of winning?

5 in 1000	1
10 in 1000	2

Answer: .....

[Enumerator: If the answer is wrong, explain with example until the correct answer is given. Write down how many times you had to explain. If the respondent did not have it right after a third explanation, explain the answer and write 4. ]

**Example3/ Question PT3.** Now, suppose there are two roads that are both very prone to accidents. The risk of dying on road A is 1 in 1000 and the risk of dying on road B is 3 in 1000. [Enumerator: Show the grid table-4 and grid table 5, when explaining]. Which road is more risky to take?

Road A	1
Road B	2

[Enumerator: If the answer is wrong, explain with example until the correct answer is given. Write down how many times you had to explain. If the respondent did not have it right after a third explanation, explain the answer and write 4. ]

## Appendix A2: Training - Explaining risk reduction

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**Example 4:** Suppose the average risk of dying for an adult person during the next 5 years is 40 in 1000. [Enumerator: show grid table 6 when explaining].

Suppose a reduction in mortality risk, through some kind of public measure, could reduce the mortality risk from 40 in 1000 to 35 in 1000

[Enumerator: show grid table 6 and grid table 7 together to explain the difference].

This means that, on average, 5 out of 40 would be saved by the measure.

**PT4.** Do you understand this risk reduction?

Yes 1

No 2

[Enumerator: If no, explain again and make sure that the respondent understands and write down how many times you had to explain. If the respondent has not understood after three times, continue and write 4]

**Example 5:** Similarly, if the risk was reduced from 40 in 1000 to 20 in 1000[Show grid table 6 and grid table 8 together to explain the difference], then 20 out of 40 would be saved on average.

**PT5.** Do you understand this risk reduction?

Yes 1

No 2

[Enumerator: If no, explain again and make sure that the respondent understands and write down how many times you had to explain. If the respondent has not understood after three times, continue and write 4]

Answer:

**Example 6:** If the risk was reduced from 40 in 1000 to 10 in 1000[show grid table 6 and grid table 9 together to explain the difference], then 30 out of 40 would be saved on average.

**PT6.** Do you understand this risk reduction?

Yes 1

No 2

[Enumerator: If no, explain again and make sure that the respondent understands and write down how many times you had to explain. If the respondent has not understood after three times, continue and write 4]

Answer:

**Example 7/ Question**

**PT7.** Which of the above risk reductions would you prefer?

[Enumerator: Show the cards and let the respondent point]

a) 40 in 1000 to 35 in 1000

b) 40 in 1000 to 20 in 1000

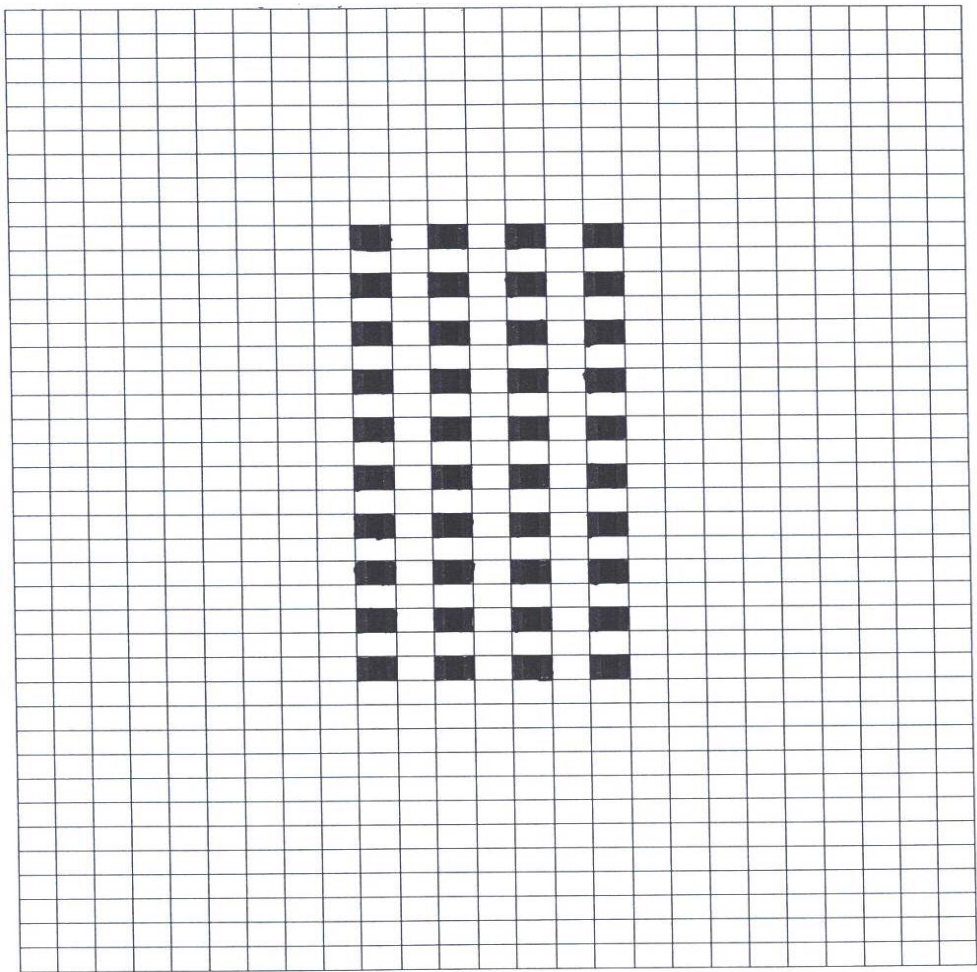
c) 40 in 1000 to 10 in 1000

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**Appendix A3: Grid table showing mortality risk of an adult in the next five years as 40 in 1000**

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**Appendix B**

**Table 1. Follow-up questions for stating zero WTP (N = 79)**

		Sub-sample of respondents who would want free vaccination (77%)	Sub-sample of respondents who would not want free vaccination (23%)
Reasons for not being willing to pay for vaccination <sup>a</sup>		% of respondents agree	
i)	I cannot afford vaccinations, even though I believe it is good to have them.	79%	-
ii)	I think the government should pay for the vaccinations.	77%	11%
iii)	I do not think the vaccine would really be safe.	-	17%
iv)	I do not think it is possible to reduce the mortality risk by vaccines.	7%	33%
v)	I do not believe in reducing mortality risk by any means.	7%	44%
vi)	Other reasons stated by the respondents: Reluctant to answer, not interested, dislike vaccination, not sure if (s) he would be willing to pay for vaccination.	3%	39%

<sup>a</sup> The lists of possible reasons were read to them and the respondents were allowed to choose more than one reason. They were also allowed to express other reasons. Respondents who had chosen any response than (i) or had chosen more than one responses are believed to have provided protest zeros when answering the WTP question.

**Table 2 Probit regression of scenario rejection (N=79)**

Variable	Marginal effects	Standard error
Received training in the survey	-0.120	0.085
50% risk reduction	-0.067	0.081
Age in years	0.005	0.002
Low education <sup>a</sup>	0.144	0.093
Muslim religion	0.416***	0.145
Log (income per capita)	0.477	0.482
Having chronic illness	-0.065	0.084
Currently smoking	-0.138	0.109

Superscripts \*\*\*, \*\*, \* denote statistical significance at the 1 %, 5%, and 10% level, respectively.

<sup>a</sup> We cannot estimate the marginal effect of high education as all eight observations from this group are dropped because, for this group, all the zero WTPs imply a scenario rejection.